526 Rec'd PCT/PTO 14 OCT 2000

FORM PTO-1390 (REV. 1-98) U.S DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY 'S DOCKET NUMBER
WLAN.P-001

U.S. APPLICATION NO (If known, see 37 CFR 1.5
09/673340

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/CH99/00150	14 APRIL 1999	15 APRIL 1998

TITLE OF INVENTION
STRUCTURAL COMPONENT CONSISTING OF FIBRE-REINFORCED THERMOPLASTIC PLASTIC

APPLICANT(S) FOR DO/EO/US
KAGI

EL556132111US

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Aplication under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371 (c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
    ☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:

Copy of English Language Version of Abstract
Copy of PCT Request
Notification of Submission of Priority Document
Notification of Receipt of Record Copy
International Preliminary Examination Report
International Search Report
Small Entity Statement

430 Rec'd PCT/PTO 14 OCT 2000

U S APPLICATION NO (if known, see 37 CFR 1 5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/673340	PCT//99/00150	WLAN P-001

				CALCULATIONS	PTO USE ONLY
17 ☒ The following fees are submitted:					
BASIC NATIONAL FEE (37 CFR 1 492 (a) (1) - (5)):					
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO			$1070.00		
International preliminary examination fee (37 CFR 1 482) not paid to USPTO but International Search Report prepared by the EPO or JPO			$830.00 ~~$930 00~~		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1 445(a)(2)) paid to USPTO			$790 00		
International preliminary examination fee (37 CFR 1 482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)			$720 00		
International preliminary examination fee (37 CFR 1 482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)			$98 00		
ENTER APPROPRIATE BASIC FEE AMOUNT =				$ 830.00	
Surcharge of $130 00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1 492(e)).				$	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE	$	
Total claims	46 - 20 =	26	x ~~$22 00~~ /18.00	$ 468.00	
Independent claims	1 - 3 =	-0-	x $82 00	$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $270 00	$	
TOTAL OF ABOVE CALCULATIONS =				$ 1328.00	
Reduction of 1/2 for filing by small entity, if applicable. A Small Entity Statement must also be filed (Note 37 CFR 1.9, 1 27, 1.28).			+	$ 664.00	
SUBTOTAL =				$ 664.00	
Processing fee of $130 00 for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1 492(f)).				$	
TOTAL NATIONAL FEE =				$	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3 28, 3 31) $40 00 per property +				$ 40.00	
TOTAL FEES ENCLOSED =				$ 704.00	
				Amount to be refunded:	$
				charged:	$

a ☒ A check in the amount of $ 704.00 to cover the above fees is enclosed

b. ☐ Please charge my Deposit Account No. ________ in the amount of $ ________ to cover the above fees A duplicate copy of this sheet is enclosed.

c ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No 150610 A duplicate copy of this sheet is enclosed

NOTE: Where an appropriate time limit under 37 CFR 1 494 or 1 495 has not been met, a petition to revive (37 CFR 1 137 (a) or (b)) must be filed and granted to restore the application to pending status

SEND ALL CORRESPONDENCE TO:

021121

PATENT TRADEMARK OFFICE

SIGNATURE

Carl Oppedahl

NAME

32,746

REGISTRATION NUMBER

09/673340

Applicant or Patentee: RCC Regional Compact Car AG Attorney's Docket No. WLAN.P-001
Serial or Patent No.: To Be Assigned Filed or Issued: Herewith
For: Structural Component Consisting of Fibre-Reinforced Thermoplastic Plastic

VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) and 1.27(c)) - SMALL BUSINESS CONCERN

I hereby declare that I am

( ) the owner of the small business concern identified below:
( ) an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF CONCERN RCC Regional Compact Car AG

ADDRESS OF CONCERN Alte Feldeggstrasse 14-16, CH-8034 Zürich, Switzerland

I hereby declare that the above identified small business concern qualifies as a small business concern as defined in 13 CFR 121.3-18, and reproduced in 37 CFR 1.9(d), for purposes of paying reduced fees under Section 41(a) and (b) of Title 35, United States Code, in that the number of employees of the concern, including those of its affiliates, does not exceed 500 persons. For purposes of this statement, (1) the number of employees of the business concern is the average over the previous fiscal year of the concern of the persons employed on a full-time, part-time or temporary basis during each of the pay periods of the fiscal year, and (2) concerns are affiliates of each other when either, directly or indirectly, one concern controls or has the power to control the other, or a third party or parties controls or has the power to control both.

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the above-captioned invention which is described in

(X) the specification filed herewith
( ) Application Serial No. ________________, filed ____________________.
( ) Patent No. ____________________, issued ______________________.

If the rights held by the above identified small business concern are not exclusive, each individual, concern or organization having rights to the invention is listed below* and no rights to the invention are held by any person, other than the inventor, who could not qualify as a small business concern under 37 CFR 1.9(d) or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e). *Note: Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

NAME ____

ADDRESS ____
( ) INDIVIDUAL ( ) SMALL BUSINESS CONCERN ( ) NONPROFIT ORGANIZATION

NAME ____

ADDRESS ____
( ) INDIVIDUAL ( ) SMALL BUSINESS CONCERN ( ) NONPROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

NAME OF PERSON SIGNING Hubert A. Weber TITLE Chairman

ADDRESS OF PERSON SIGNING Lindenbergstrasse 13a, CH-8700 Küsnacht, Switzerland

SIGNATURE [signature] DATE Sept. 29, 2000

09/673340
430 Rec'd PCT/PTO 14 OCT. 2000

WLAN.P-001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Kägi, et al.
Serial No.: To be Assigned
Filed: Herewith
Title: STRUCTURAL COMPONENT CONSISTING OF FIBRE-REINFORCED THERMOPLASTIC PLASTIC

PRELIMINARY AMENDMENT

Hon. Commissioner of Patents & Trademarks
Washington, D.C. 20231

Sir:

Preliminary to the examination of the application filed herewith, please make the following amendments:

In the claims:

In claim 3, line 1, delete "or 2".

In claim 4, line 1, delete "one of the preceding claims" and insert - - claim 1 - -.

In claim 5, line 1, delete "one of the preceding claims" and insert - - claim 1 - -.

In claim 6, line 1, delete "one of the preceding claims" and insert - - claim 1 - -.

In claim 7, line 1, delete "one of the preceding claims" and insert - - claim 1 - -.

These amendments are made to eliminate multiple-dependency. No new matter has been added.

Applicant herewith submits the English language version of the abstract and requests its entry into this application.

Respectfully submitted,

Carl Oppedahl

Carl Oppedahl
PTO Reg. No. 32,746

09673340.101400

Abstract

The inventive structural component has a moulding, long fibre–reinforced thermoplastic matrix (2) and an integrated support structure (4) which consists of consolidated continuous fibre strands (3) with a thermoplastic matrix. Said support structure (4) has at least one load–transmitting inner connecting point (7) of two continuous fibre strands (3). The long fibre matrix and the continuous fibre matrix are compatible and are fused together with their mutual contact surfaces (6). This results in light supporting structural components which are easy, quick and economical to produce.

09/673340
430 Rec'd PCT/PTO 14 OCT 2000

STRUCTURAL COMPONENT CONSISTING OF FIBRE-REINFORCED THERMOPLASTIC PLASTIC

The invention concerns a structural component consisting of fibre-reinforced thermoplastic plastic in accordance with the generic term of claim 1 as well as a method for manufacturing such a structural component and an installation for implementing this method.

Such known fibre-reinforced preformed - and structural components in general can be manufactured either with cost-effective series production methods and with only a relatively low fibre reinforcement, with which - while a broad variety of shapes is possible - load-bearing functions cannot be accomplished. Or else relatively expensive, elaborate methods with a high proportion of continuous fibre are called for, which enable structural components for demanding load-bearing functions, whereby the forming here, however, frequently is limited, resp., would once again require an increased expenditure. With the known cost-effective manufacturing methods, short- or long-fibre-reinforced preformed components can be produced with a relatively low proportion of fibre and correspondingly limited mechanical characteristics, such as strength, rigidity, brittleness and creep behaviour. Such methods are, e.g., short-fibre injection moulding, which makes possible a very good shaping, but which as a result of the very limited fibre lengths utilizable (usually less than 3 mm) and the comparatively low proportions of reinforcing fibres, however, are mechanically still relatively weak and brittle. In the case of a further known method, the long-fibre extrusion, greater fibre lengths of over 5 mm, e.g., 10 - 30 mm are possible, which with a good consolidation in part make possible improved mechanical characteristics, above all also reduced thermal expansions. Various methods for the suitable corresponding-to-form feeding in of the long-fibre molten mass are known, e.g., by means of conveyor belts and blades for separating the molten mass in the mould or by means of a controlled laying device in accordance with EP 769 358.

With a corresponding-to-form feeding in, short flow paths and careful treatment of the long-fibres can be achieved. However, also with this no load-bearing structures are feasible. In particular demanding load-bearing structural components, such as, e.g., for vehicle cabins, chassis components or load-bearing body components or also for light, but stable transport containers, sports implements, etc., cannot be manufactured with this known method. In addition to the high mechanical requirements of load-bearing structural components in vehicle manufacture, apart from high strength values above all also a high creep resistance and a favourable crash characteristic with a defined adjustability and a high energy absorption are demanded. Such demanding load- bearing structural components are feasible with continuous fibre-reinforced composite components, however, they call for very elaborate, expensive manufacturing processes. These are, e.g., the squeeze moulding of plane thermoplastic continuous fibre semi-finished products (organo-sheet pressing), which, however only allows a limited shaping or else requires a once again increased effort for a more elaborate shaping. Also load-bearing structural components made of high-strength duromer composite materials can only be produced by elaborate and expensive processes, in general require relatively long cycle times and also with respect to re-cycling lead to additional problems. They are therefore not utilizable for larger series in vehicle production.

It is therefore the object of the invention presented her to overcome these limitations, resp., disadvantages of the known methods and structural components and to create a load-bearing structural component as well as a corresponding manufacturing method and to indicate an installation for the manufacture of a structural component, which can reliably fulfil demanding load-bearing functions and which structural component can be manufactured cost-effectively and in different shapes, whereby also short cyle times for a series production can be achieved. Over and above, also additional functions, such as, e.g. the introduction of forces into the structural component shall be possible.

This object is solved in accordance with the invention by a structural component in accordance with claim 1, a method in accordance with claim 21 and an installation for the implementation of the method in accordance with claim 35.

With the invention, in essence advantageous characteristics of long-fibre compression-moulded components, which make possible a broad range of shapings, combined with the high mechanical characteristics, which form the integrated load-bearing supporting structure with at least one load-transmitting internal connecting area of the coninuous fibre strands, in that in a simple manner in one manufacturing process relatively cost-effectively and with short cycle times light and load-bearing structural - and preformed components can be made.

The dependent claims concern advantageous further developments of the invention, which for various applications make possible particular advantages with respect to producibility, mechanical characteristics, weight and manufacturing costs as well as additional functions.

In the following, the invention is further explained on the basis of embodiments and Figures. These show:

Figs. 1a,b a structural component in accordance with the invention in cross-section through a continuous fibre strand and at an internal connecting area,

Figs. 2, 3 arrangements of continuous fibre strands as load-bearing structure in structural components,

Figs. 4, 5 twisted and wrapped continuous fibre strands,

Figs. 6a, b a load-bearing insert on a continuous fibre strand,

Fig. 7 a structural component with inlays,

Figs. 8, 9 structural components with three-dimensional profile cross-sections,

Fig. 10 an external connecting area,

Fig. 11 a structural body formed out of several structural components,

Fig.12 a structural body, formed out of two half-shells,

Fig. 13 a transport mesh with laid continuous fibre strands,

Fig. 14 a structural component with two layers of continuous fibre strands,

Fig. 15 a vehicle side wall with framework-like supporting structure,

Fig. 16 a continuous fibre strand with an eye moulded into it,

Fig. 17 a holding element at the end of a continuous fibre strand,

Fig. 18 a movable fixing pin for the positioning of continuous fibre strands,

Figs. 19a, b installations for the manufacturing of structural components,

Figs. 20a, b shapings of the laying path in a form tool,

Fig. 21 a thermal conditioning of a laying path,

Figs. 22a, b, c guiding - and pressing on means for the laying of continuous fibre strands,

Figs. 23a, b a connecting layer as interface with a transition zone,

Figs. 24a, b, c load-transmitting internal connecting areas of two continuous fibre strands,

Fig. 25 a supporting structure arrangement of continuous fibre strands with fixing - and tensioning elements.

The Figs. 1a, 1b, for example, illustrate the structure of a structural component made of fibre-reinforced thermoplastic plastic material. Fig. 1a illustrates a cross-section through a continuous fibre strand 3 and Fig. 1b shows a load-transmitting internal connecting area 7 of two continuous fibre strands. The structural component has a shaping long-fibre-reinforced thermoplastic matrix 2 and an integrated load-bearing supporting structure 4, which is formed by consolidated continuous fibre strands 3 with a thermoplastic matrix. Essential here is the fact, that the long-fibre matrix and the continuous fibre matrix are compatible with one another to such an extent, that

they are fused together at their mutual contact surfaces 6 (interface), i.e., that they are thermoplastically joined. The supporting structure 4 has at least one load-transmitting internal connecting area 7 between two continuous fibre strands 3. In order to achieve particularly good connections at the interfaces, the interfaces 6 can at least in part be implemented as connecting layers 6a, which form a transmission zone between the long-fibre matrix 2 and the continuous fibre strands 3. This is further explained in the Figs. 23a and 23b. Advantageously, the interfaces 6 for the purpose of an optimum connection and load-transmission from the continuous fibre strands to 3 the long-fibre mass 2 can also be designed as enlarged structured interfaces 6b manifesting structured uneven extrusions. This is also illustrated in the Figs.4, 5.

Fig. 1b illustrates a force-transmitting internal connecting area 7 between two continuous fibre strands 3, which are of decisive significance for the mechanical stability of the supporting structure 4. For a good load transmission, to do so an optimum thermoplastic connection, in preference at relatively large interfaces F7, has to be produced. To achieve this, the strands 3 at the connecting area 7 are strongly flattened and widened. Further illustrations for this are shown in the Figs. 24a, b, c.

The continuous fibre strands 3, depending on requirements of the resulting structural component, can be utilized in various shapes, both with respect to cross-sectional shapes (round, flat, etc.), as well as with respect to their composition and surface structure. Thus, e.g., UD-fibres, prepregs, rovings and in complement fabric tapes, knitted or fibrous layers can be utilized.

Examples of this supporting structure 4 are shown in the Figs. 2 and 3, whereby the continuous fibre strands 3 in preference form at least one closed mesh 10 with a load-transmitting internal connection area 7. Fig. 2, as an example, illustrates a closed mesh or loop 10 as supporting structure and outer frame of a vehicle tailgate 95, the

shape of which is formed by the long-fibre matrix 2.

Fig. 3 shows a supporting structure 4, in the case of which the continuous fibre strands, running in different directions, form a framework-like pattern 11 and are thermoplastically connected at internal connection areas 7. The supporting structure 4 of a structural component in doing so can be composed of a single strand, or it is possible also to utilize several strands, if so required with differing thicknesses and cross-sectional shapes. It is important, that a material connection between the long-fibre matrix 2 and the continuous fibre strands 3 is achieved, for which reason the matrix materials of the two elements in preference are identical, at least, however, compatible to such an extent, that the two materials are mixed together by means of diffusion at the interface layers 6.

Suitable as matrix materials for the long-fibre reinforcement 2 and the continuous fibre strands 3 are polypropylene (PP), polyamide (PA), polyethylenetherephtalate (PET), polybutylenetherephtalate (PBT), thermoplastic polyurethanes (PUR), polycarbonate (PC) as more cost-effective technical plastic materials for corresponding applications, while polyimides (PI), polyphenylsulphide (PPS) or polyetheretherketone (PEEK) are conceivable for particularly demanding applications.

As reinforcing fibres 13 of the continuous fibre strands 3, in preference glass, for demanding applications also carbon or aramide are utilized, while for the long-fibre reinforcement 12 in most instances cost-effective glass fibres are sufficient.

With the continuous fibre strands of the supporting structure 4, the high mechanical properties of the structural components are achieved, while the long-fibre

reinforcement 2 provides a shaping - and supporting function. In this it is essential, that between the continuous fibre strands and the long-fibre reinforcement a very good contact and a good load transmission is achieved, for which the long-fibre reinforcement should also have a sufficiently high fibre content, in order with this to also minimize the differences in the thermal expansion. The reinforcement of the long-fibre matrix should therefore have a fibre content of at least 10 % by volume, in preference 15 to 25 % by volume. While the continuous fibre strands 3 have a fibre content of at least 40 % by volume, in preference of 45 to 60 % by volume.

In order to be in a position, dependent on the laying paths 39 (Fig. 13), to bend and also if so required to shape the continuous fibre strands, these are in preference twisted in accordance with Fig. 4. In order to hold them together well also during pressing, the continuous fibre strands 3 can also be wrapped (16 in Fig. 5) or enveloped by a braided tube 17. With this, also a structured, enlarged connecting layer 6a with shapings can be achieved. A further advantageous improvement of the contact can be obtained with needle-bonding 18, in the case of which fibre ends protrude from the strands 3 in all directions and therefore reach into the re-melted long-fibre mass 2. Fig. 4 illustrates a round -, Fig. 5 a flat cross section. The continuous fibre strands 3 have to a greater extent longitudinally oriented continuous fibres, which are fully impregnated with matrix material, compacted and consolidated. During the manufacture of the consolidated continuous fibre strands, the twisting can also be carried out with differing strengths, depending on whether during the laying on the laying path greater or smaller bends occur, i.e., a continuous fibre strand can in the zone of greater bending have a correspondingly stronger twisting and in zones with weaker bending a very low twisting. If no lateral bends occur, it is also possible to utilize flat strands without any twisting, i.e., in essence UD strands.

The long-fibre reinforcement produced by extrusion in preference has greater fibre lengths than is possible in the case of injection moulding. To achieve this, a great

proportion of the fibres should have a length of at least 5 mm, whereby preferably the fibre length to a great extent can lie within a range of 10 to 30 mm. Important is an impeccable impregnation, mixing and consolidation also of the long-fibre reinforcement.

Since the plastified continuous fibre strands 3 during laying can be moved and re-shaped in any direction, in a simple manner also load-bearing inserts 21, as depicted in Fig. 6, can be joined to the continuous fibre strands, resp., enveloped by them. With this, load-bearing elements, e.g., fixing elements, such as safety belt anchor points in vehicle cabins, can be manufactured (Fig. 15).

Fig. 6a in cross section and Fig. 6b from above show an example of a two-part insert 21, which by the closing of the mould is pressed together to the required position and as a result by means of a corresponding flank 19 can in addition also tension the continuous fibre strands 3 in a defined manner. In the insert, a screw thread 20 is attached. On the right side in Fig. 6a lies the overlap of the continuous fibre strand 3, which here is correspondingly pressed together and deformed to a greater extent.

Depending on the requirements of the structural component, apart from inserts also other inlays can be incorporated, as is illustrated in Fig. 7. Here, for example, a high-strength continuous fibre strand-reinforced tubular profile component 23 with a flattened end is connected to a continuous fibre strand 3, whereby here in addition a local continuous fibre strand fabric inlay 24 supports the load introduction. Important is always the impeccable thermoplastic connection of the elements.

The wide-ranging design - and shaping possibilities of the structural components in accordance with the invention are illustrated in the Figs. 8 and 9, which form three-

dimensional „profile cross sections“ 26, 27. Fig 8 in doing so shows a slightly open U-profile composed of three continuous fibre strands 3.1 - 3.3, which is connected with the long-fibre mass 2 through a ribbing 28.

Fig. 9 illustrates, for example, a section through a frame girder 27 of a vehicle cabin, which contains a flange 29 for receiving a window pane and which in turn has strengthening ribs 28 in combination with the load-bearing profiled, flat continuous fibre strands 3.

Advantageously and depending on the application, open external connecting areas 8 can be formed on the structural components, which consist of continuous fibre strands, in order by means of this to assure the best possible load introduction into the structural component, as is illustrated in the example of Fig. 10 by corresponding form tool components 51.1, 51.2 (refer to Fig. 19). With this, structural bodies 90 can be assembled out of several individual structural components 1 to a great extent in any desired manner, in that these structural components are connected to one another at external connecting areas 8, which are preferably formed out of continuous fibre strands. This in preference can be accomplished by welding or if need by also by glueing. In analogy to the internal connecting areas 7, these external connecting areas 8 too are preferably designed with a large surface area.

The example of Fig. 11 shows a vehicle cabin, which is composed of a floor group 96, two side walls 97, a rear part 98 and a front part 99 by connecting the areas 8.

Fig. 12 illustrates a further example of a structural body, which is composed of two structural components 1, here designed as half shells: a U-profile 92 and a cover 93, which together form the hollow profile support 91 with differing cross-sectional

shapes of the CF strands 3.

The following method is suitable for manufacturing structural components in accordance with the invention, which can, e.g., be carried out with an installation as illustrated in Fig. 19:

A plastified, long-fibre-reinforced plastic mass is deposited corresponding-to-form in an open, two-part form tool 51.1, 51.2 in a press, whereby in the same cycle with a laying device 54 consolidated, plastified continuous fibre strands 3 are laid into the form tool before and/or after the long-fibre-reinforced mass locally defined along predefined laying paths 39 and held in position by means of fixing means 40 to such an extent, that with the pressing and closing of the form tool 51 a desired supporting structure 4 of the continuous fibre strands 3 is created and whereby with the pressing above all simultaneously also an impeccable thermoplastic connection between the long-fibre mass 2 and the continuous fibre strands 3 is produced at the interface 6.

In doing so, in preference first the continuous fibre strands 3 are laid in the lower form tool 51.1 and subsequently the long-fibre-reinforced mass 2 is fed into it, whereupon then the pressing takes place.

In another variant of the manufacturing method, the continuous fibre strands 3 can be laid on a transport mesh or grid 31 for the formation of a preformed supporting structure 4a, fixed onto it and subsequently transferred to the open form tool 51 (refer to Fig. 19b). Here the laying of the continuous fibre strands 3 and the feeding-in of the long-fibre mass into the form can take place side by side and simultaneously, as a result of which shorter manufacturing cycles can be achieved. Fig. 13 shows such a transport mesh 31 for laying the continuous fibre strands onto a inlay mesh 32 in a

transfer frame 33 for the transfer to the press. The inlay mesh can consist of a coarse meshed textile mesh (e.g., with a mesh width of 4 to 10 mm) and can remain in the structural component after the pressing. The transfer frame 33 is then equipped with a new inlay mesh 32 for the new cycle. By melting the continuous fibre strands into the inlay mesh, a very good fixation corresponding to the required laying path 39 can be obtained.

Utilized as flexible inlay meshes can be, e.g. also fibreglass meshes. By pressing onto the form tool 51, the desired three-dimensional shape of the supporting structure 4a, 4 can be achieved. It is also possible, however, to utilize light, non-deformable metallic wire meshes, with which a three-dimensionally preformed supporting structure 4a can be produced. The transport meshes 31 can also only cover partial areas, in which the laying paths 39 of the continuous fibre strands 3 lie. A further variant consists in the laying of the preformed supporting structure 4a onto a heated auxiliary mould 35 outside the press, as is explained in connection with Fig. 19b.

Fig. 14 shows a structural component with two layers of continuous fibre strands 3.1 and 3.2, which correspond to partial structures 4.1 and 4.2. This can be manufactured by first laying the continuous fibre strands 3.1 in the lower mould half 51.1, subsequently feeding-in the long-fibre mass 2 and carrying out a first pressing. Then the form tool and the press are opened again and a laying path on the long-fibre mass 2 for a second layer of continuous fibre strands 3.2 is superficially melted open by local heating, whereupon a second layer of continuous fibre strands 3.2 is laid, subsequently pressed and in doing so thermoplastically connected with the long-fibre mass 2. This melting open can, e.g., be effected by means of an IR heating to such an extent, that a complete thermoplastic connection is achieved.

Fig. 15, as an example, schematically illustrates the laying of continuous fibre strands along a laying path 39 as a structural component for a vehicle side wall, which here form a framework-like supporting structure 11. The CF strands 3 are here fixed by

means of fixing pins 61, deviating elements 62 and also inserts 21 (here as safety belt anchor points) onto the laying path 39 (also refer to Figs. 6 and 18). In doing so, one or several strands 3, in part also in double or multiple routing can be laid with internal connecting areas 7.

The laying and fixation of the continuous fibre strands 3 can, e.g., be carried out in the following manners:

- in that first the beginning 3A of a continuous fibre strand is fixed to the tool 51 and subsequently laid under slight tension, and its end 3E once again, while maintaining an appropriate tension, is fixed to the form tool 51,
- in that the continuous fibre strand 3 is pressed onto the form by the laying device 54 with such dosing, that the strand lies flat and assumes the desired position and cross-sectional shape in the form tool 51 (Fig. 22),
- in that the continuous fibre strand 3 at least in part, i.e., at the beginning 3A, at direction changes of the laying path and at the end 3E is melted onto the mould (41 in Fig. 21),
- in that the continuous fibre strands 3 through contact with the cooler form tool 51 are solidified to such an extent, that they remain fixed to the form tool during the pressing and that they, however, in doing so on the other hand at their contact surfaces 6 again fully fuse together with the long-fibre mass 2, which has been filled-in in hot condition,
- in that in molten condition at the beginning 3A and end 3E of a continuous fibre strand eyes 43 are melted in by pressing and partial solidifying (Fig. 16) and whereby these shaped ends 3A, 3E after the laying of the continuous fibre strand 3 are superficially melted open again by the hot long-fibre molten mass and thermoplastically connected
- and in that at the ends 3A, 3E of the melted-open continuous fibre strands holding elements 45 with plug-in holes 46 are melted open, which after the laying of the long-fibre mass 2 fuse together with it (Fig. 17).

Fig. 16 shows an end 3a or 3E of a continuous fibre strand, into which in molten condition an eye 43 has been formed, which in the again solidified condition can be plugged into a fixing pin 61 of the form tool for laying.

Fig. 17 shows holding elements 45, which at ends 3A, 3E of the continuous fibre strands are melted on and in which plug-in holes 46 for the fixation to fixing pins 61 are punched. In the example illustrated, two holding elements are produced by punching along the cutting line 47. The holding elements 45 in preference consist of the same material as the continuous fibre strands 3.
The eyes 43 and the holding elements 45 can also be arranged within the continuous fibre strands 3.
Also in the installation (Fig. 19), means of fixation are foreseen for fixing the continuous fibre strands in the desired final position during the manufacturing process. As shown in Fig. 18, to achieve this it is also possible to insert fixing pins 61 or deviating elements 62 (Figs. 2, 15) for the continuous fibre strands, which are located on the bottom part of the form tool 51.1.

These fixing pins 61 and deviating elements 62 can also be designed to be movable (63) and be pressed upwards under an appropriately selected pre-tension. When the press is closed, the fixing pin is then pushed downwards through the upper part 51.2 of the form tool. This movement of the fixing pins 61 can also be effected be means of a controlled drive 64, e.g., electrically or in the form of a hydraulic piston, which can also be utilized for the removal from the mould. The fixing pins 61 can also be affixed outside the structural component to be manufactured, but still inside the form tool. The protruding part can then be cut off after the manufacture (refer to cutting lines 47 in Figs. 3 and 10).
By an inclined displacement axis 60 during pressing and compression a tensioning effect can also be atteined (as shown in the example of Fig. 6a).

Fig. 19a depicts an installation for the manufacturing of structural components with a long-fibre plastifying - and feeding-in device 52, a two-part form tool 51.1, 51.2 in a press 56 and with a continuous fibre strand plastifying device 53, which has an assigned laying device 54, as well as with a control system 57 for the time-co-ordinated controlling of the movement of the components of the installation and for temperature-conditioning, for laying the continuous fibre strands 3 and for the corresponding-to-form feeding-in of the long-fibre molten mass 2 as well as for the thermoplastic connecting of continuous fibre strands 3 and long-fibre matrix 2.

While in the installation according to Fig. 19a the preformed supporting structure 4a is directly laid and formed by the laying device 54 in the tool 51, Figure 19a as a variant illustrates the formation of the preformed supporting structure 4 outside the press with subsequent transfer into the tool 51 in the press 56 by means of a transfer device 55. To accomplish this, the preformed supporting structure 4a made out of the plastified continuous fibre strands 3 is laid onto an auxiliary mould 35 or onto a suitable substrate, after a slight cooling down to below the melting point, so that an adequate non-deformability is obtained, transferred into the tool 51, there heated up again to such an extent, that with the subsequent filling-in of the hot long-fibre mass 2 and with the pressing a complete thermoplastic connection is produced at the interfaces 6 between the continuous fibre structure 4 and the long-fibre mass 2. Or the preformed supporting structure 4a is laid onto a transport mesh 31 (Fig. 13) and transferred into the press with it. Suitable process temperatures for the materials polypropylene-glass are, for example: for a non-deformable transfer 140° - 150° C, for the hot long-fibre mass 230° - 250° C and for the interfaces 6 during pressing at least 200° C.

Fig. 25 illustrates various examples of fixing - and tensioning elements, with which a preformed supporting structure 4a made out of continuous fibre strands 3.1 to 3.4 is fixed and held within the tool 51 during the pressing, so that following the pressing

the desired finished integrated supporting structure 4 in the long-fibre matrix results. To achieve this, here on the lower form tool 51.1 various fixing elements 61, holding elements 45, deviating elements 62 and tensioning elements 80 are attached. Also clamping elements 81, e.g., made of aluminium sheet metal, which are pressed together by the pressing, can be utilized for holding the continuous fibre strands together. With this method, in addition simultaneously also, e.g., decorative surfaces 85 (Fig. 19a) can be affixed to one side of the structural component 1 (e.g., for a tailgate 95 in accordance with Fig. 2). On the other side the continuous fibre strands 3, resp., the supporting structure 4 are integrated. By means of such two-side inlays or supports of a flat surface structural component, the thermal distortion can be essentially reduced.

The Figs. 20 to 22 show further guiding - and fixing means of the installation. In Fig. 20a, b shapings in the form tool 51 are depicted, e.g., like steps 67 in Fig. 20a and channels 66 in Fig. 20b, into which the continuous fibre strands are laid and during the pressing are held in place, i.e., on the predefined laying path 39.

Fig. 21 illustrates a thermal conditioning on the laying path 39, resp., at the shapings like channels and steps. This can, e.g., consist of a thermal insulating layer 73, which reduces the cooling down of the continuous fibre strand. Also a thermal conditioning 74 can be appropriate, with which the continuous fibre strand 3 depending on the process step can be heated or cooled. A structuring 75 of the surface, if intended, can also reinforce a local fixation of the CF strands 3 on the form tool 51.

The Figs. 22a to c show guiding - and pressing-on means of the laying device 54. A continuous fibre strand here is guided by guiding rollers 68 on the laying path and by a pressure roller 69 by means of a corresponding control system is deformed and pressed on to such an extent, that on the one hand the desired cross-sectional shape is

produced and that on the other hand the continuous fibre strand is also pressed onto the form tool 51 and fixed. The laying device 54 can also have two or more pressure rollers (69.2), which can be changed during the laying, in order to by means of this achieve differing shapes, e.g., at connecting areas 7.

The installation can also be assigned a consolidating device 58 for the continuous fibre strands. The manufacturing of it can be effected, e.g., out of continuous fibre rovings, which are impregnated with matrix material and compacted and consolidated with a suitable torsion. Or else it is also possible to carry out a re-forming of UD (uni-directional) tapes.

A further variant of the installation comprises a store 59 for the continuous fibre strands, from which the cut-to-length and consolidated strands 3 are taken, completely melted open and laid. In doing so, in preference the continuous fibre strands in the store 59 are preheated to almost their softening temperature.

If so required, a heating gas - or protective gas conditioning facility 71 can also be foreseen in the installation, in order to on the one hand prevent any oxidizing of the matrix materials and on the other hand to locally dosed heat, resp., cool continuous fibre strands and laying paths 39 in accordance with the process steps.

The Figs. 23 illustrate optimum connections at the interface 6 between continuous fibre strands and long-fibre matrix. Fig. 23a shows an interface 6, which is designed as connecting layer 6a and which can have a layer thickness d of less than 1 mm, e.g., 0.1 to 0.5 mm. This connecting layer is formed by a mixing - or transition zone, in that the continuous fibre proportion reduces and the long-fibre proportion increases, with which a particularly good thermoplastic connection between continuous fibre

strands 3 and long-fibre mass 2 can be achieved. Such connecting - or mixing layers 6a, e.g., can be produced by roughening, needle-bonding or structured surfaces of the continuous fibre strands with protruding fibres. With this, a close contact of fibre mixture of continuous fibre strands and long-fibre layer is achieved and with it a corresponding balanced transition of the mechanical properties without any sudden changes. This is illustrated in Fig. 23b, which shows the course of the modulus of elasticity (in EF-direction) in the transition zone. Along the layer thickness d, the modulus of elasticity here continuously reduces from the high value of the continuous fibre strand 3 to the several times lower value of the long-fibre mass 2.

The Figs. 24a, b, c illustrate examples of good load transfers at internal connecting areas 7 between two continuous fibre strands 3.1, 3.2. In Fig. 24a, between two crossing continuous fibre strands a thin intermediate layer 9 of long-fibre material is built-in, which helps to prevent harmful pockets of air, inasmuch as during the pressing any possible pockets of air can be relatively well guided out through the long-fibre mass. In addition, this connecting area F7 too is designed to have a relatively large surface area. In Fig. 24b, two continuous fibre strands 3.1, 3.2 are longitudinally connected together through an extensive connecting area F7, which in addition is widened approximately 2 times and which can also be structured, resp., shaped for the purpose of enlarging the mutual contact surface area. Over and above this it is advantageous, if the layer thickness d3 of the continuous fibre strands 3 is at least as great as the layer thickness d2 of the long-fibre matrix 2 situated above it. Fig. 24c shows an example of a three-dimensional U-shaped profile with flanges, which is composed of two continuous fibre strands (here as flat tapes 3.1, 3.2) at a connecting area 7. Also this load-transmitting connecting area 7 is designed with a large surface area (F7). Complemented by a ribbing made of long-fibre mass in between, this results in a profile resistant against bending.

In summary, when laying the continuous fibre strands and in order to form the

supporting structure with internal load-transmitting connecting areas, the following important criteria have to be fulfilled:

a) The continuous fibre strands have to be laid defined with respect to position on a laying path and

b) in the desired cross-sectional shape;

c) they must not be inadmissibly displaced or deformed during pressing, so that in the final condition after the pressing the supporting structure 4 is present in the desired position and cross-sectional shape;

d) in the final condition they have to be fused together with the long-fibre mass at the interfaces 6 as well as

e) with the supporting structures 4 at the internal connecting areas 7 in a load-transmitting manner.

The following means can, for example, be utilized, in order to fulfil these criteria:

- Fix the continuous fibre strands at their beginning 3A and along the laying path at those points necessary, fix and tension them at deviating means and fixing pins with respect to their shape;
- fix them on the floor of the tool by pressing-on and melting;
- by means of a corresponding shaping of the tool with channels and steps, hold the laid continuous fibre strands firm against displacement;
- feed-in and distribute the long-fibre masses in such a manner, that during pressing only minimal flow paths of the long-fibre mass occur on the laying paths of the continuous fibre strands;
- feed-in a preformed supporting structure 4a, fix it and with the pressing of the tool form correspondingly bring it to the final shape 4;
- process control and thermal conditioning of the continuous fibre strands in such a manner, that their surface during pressing fuses together as interface with the long-fibre mass.

With this, in a simple and cost effective manner in short cycles light and stable load-bearing structural components, i.e., light-weight structural components with a to a

great extent free shaping can be manufactured.

Within the scope of this description, the following designations are used:

1	Structural component
2	Long-fibre matrix
3	Continuous fibre strands
3A	Beginning of 3
3E	End of 3
4	Supporting structure
4.1, 4.2	Partial structures
4a	Preformed supporting structure
6	Interface
6a	Connecting layer
6b	Structured interface
7	Internal connecting areas
8	External connecting areas
9	Thin intermediate layer
10	Mesh
11	Framework(-like)
12	Long-fibre reinforcement (LF)
13	Continuous fibres (CF)
15	CF twisted
16	CF wrapped
17	CF braided
18	Needle-bonded
19	Flank, rising
20	Screw thread
21	Insert, load-bearing
22	Inlays
23	Tubular profile part

24	Fabric inlay
25, 26, 27	Three-dimensional (spatial) profile sections
28	Ribs
29	Flange
31	Transport mesh
32	Inlay mesh
33	Transfer frame
35	Auxiliary mould
39	Laying paths
41	Melt
43	Eyes on 3
45	Holding elements
46	Plug-in holes
47	Cutting, cutting lines
50	Installation
51	Form tool
51.1, 51.2	Lower -, upper mould half
52	LF plastifying and feeding device
53	CF plastifying device
54	Laying device
55	Transfer device
56	Press
57	Control system
58	CF consolidation device
59	CF strand store
60	Inclined displacement axis
61	Fixing pins
62	Deviating elements
63	Movable
64	Controlled drive

65	Pre-tension
66	Channels in 51
67	Steps
68	Guide rollers
69	Pressure rollers
71	Protective gas / heating gas conditioning
73	Insulation
74	Thermal conditioning
75	Structured surface
80	Tensioning elements
81	Clamping elements
85	Decorative material
90	Structural body
91	Hollow profile girder
92	U-profile with ribs
93	Cover
95	Tailgate
96	Floor group
97	Side walls
98	Rear part
99	Front part
CF	Continuous fibre
LF	Long-fibre
E	Modulus of elasticity
d	Thickness of 6a
d2	Thickness of 2
d3	Thickness of 3
F7	Large surface area 7

Claims

1. Structural component (1) made out of fibre-reinforced thermoplastic plastic material, characterized by a shaping, long-fibre-reinforced (LF) thermoplastic matrix (2) and an integrated load-bearing supporting structure (4) consisting of consolidated continuous fibre strands (CF) (3) with a thermoplastic matrix, whereby the long-fibre matrix and the continuous fibre matrix are compatible to such an extent, that they at their mutual interfaces (6) are fused together, resp., thermoplastically bonded and whereby the continuous fibre strands (3) of the supporting structure (4) have at least one load-transmitting internal connecting area (7) of two continuous fibre strands.

2. Structural component in accordance with claim 1, characterized in that the interfaces (6) at least partially are designed as connecting layers (6a), which form a transition zone between long-fibre matrix (2) and continuous fibre strands (3).

3. Structural component in accordance with claim 1 or 2, characterized in that the interfaces (6) are designed as structured interfaces having uneven shapings (6b).

4. Structural component in accordance with one of the preceding claims, characterized in that the continuous fibre strands (CF) of the supporting structure form at least one closed mesh (10).

5. Structural component in accordance with one of the preceding claims, characterized in that the continuous fibre strands run in different directions and are thermoplastically bonded together at internal load-transmitting connecting areas (7) in the manner of a framework.

6. Structural component in accordance with one of the preceding claims, characterized in that the matrix material of the long-fibre reinforcement (2) and of the continuous fibre strands (3) in preference is identical, at least, however, compatible to such an extent, that the two materials are mixable together at the interfaces (6) through diffusion.

7. Structural component in accordance with one of the preceding claims, characterized in that the matrices of the long-fibre-reinforcement (2) and of the continuous fibre strands (3) consist of polypropylene (PP), polyamide (PA), polyethylenetherephtalate (PET), polybutylene-therephtalate (PBT), thermoplastic polyurethanes (PUR), polycarbonate (PC), polyacrylics, polyimide (PI), polyphenylsulphide (PPS) or polyetheretherketone (PEEK) and that the reinforcing fibres (13) of the continuous fibre strands in preference consist of glass, carbon or aramide and the long-fibre reinforcement (12) preferably consists of glass.

8. Structural component in accordance with claim 1, characterized in that the reinforcement (12) of the long-fibre matrix has a fibre content of 15 - 25 % by volume and that the continuous fibre strands (13) have a fibre content of at least 40 %, in preference 45 - 60 % by volume.

9. Structural component in accordance with claim 1, characterized in that the continuous fibre strands are twisted (15).

10. Structural component in accordance with claim 1, characterized in that the continuous fibre strands are needle-bonded (18), wrapped (16) or enveloped by a braided (17) tube.

11. Structural component in accordance with claim 1, characterized in that the long-fibre reinforcement (12) has a great proportion of fibres with a length of at least 5 mm, whereby the fibre length preferably to a great extent is within a range of 10 - 30 mm.

12. Structural component in accordance with claim 1, characterized in that load-bearing inserts (21) (e.g., seat-belt anchoring points) are integrated, which are directly connected with the continuous fibre strands (3), resp., are surrounded by them.

13. Structural component in accordance with claim 1, characterized in that further inlays (22) are integrated, e.g., high-strength continuous fibre-reinforced tubular profile parts (23) and / or local continuous fibre fabric inlays (24), which are connected with the continuous fibre strands and fused together with the long-fibre matrix.

14. Structural component in accordance with claim 1, characterized in that the continuous fibre strands form „three-dimensional" profile cross sections (25, 26, 27).

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15. Structural component in accordance with claim 1, characterized in that external connecting areas (8) of the continuous fibre strands are foreseen.

16. Structural component in accordance with claim 1, characterized in that the layer thickness (d3) of the continuous fibre strands (3) is at least as great as the layer thickness (d2) of the long-fibre matrix (2) located above it.

17. Structural component in accordance with claim 1, characterized in that the load-transmitting connecting areas are designed with a large surface area (F7).

18. Structural component in accordance with claim 1, characterized in that the connecting areas (7) have a thin long-fibre intermediate layer (9).

19. Structural body (90) consisting of at least two structural components (1) in accordance with claim 1, which structural components are in preference connected to one another at external connecting areas (8) of the continuous fibre strands.

20. Structural body with at least two structural components (1) in accordance with claim 1, which are designed as half-shells and are connected to one another and, e.g., in the form of a U-profile (92) together with a cover (93) form a hollow profile girder (91).

21. Method for the manufacturing of a structural component in accordance with claim 1, characterized in that a plastified, long-fibre-reinforced plastic mass (2) is laid corresponding-to-form into an open, two-part form tool (51) in a

press and that within the same cycle before and/or after the feeding-in of the long-fibre-reinforced mass (2) by means of a laying device (54) or of a transfer device (55) a preformed supporting structure (4a) with internal connecting areas (7) made of consolidated, plastified continuous fibre strands (3) is laid in the tool and formed or formed outside and transferred into the tool and by means of fixing means is held in place to such an extent, that with the pressing and closing of the form tool a desired supporting structure (4) of the continuous fibre strands (3) is produced and whereby with the pressing a thermoplastic bonding at the interface (6) between the long-fibre mass (2) and the continuous fibre strands (3) is produced.

22. Method in accordance with claim 21, characterized in that first the continuous fibre strands (3) are laid along a predefined laying path (39) into the lower mould half (51.1), thereafter the long-fibre-reinforced mass (2) is fed-in onto it and then the pressing takes place.

23. Method in accordance with claim 21, characterized in that the continuous fibre strands (3) for the forming of the preformed supporting structure (4a) are laid onto a transport mesh (31), fixed on it and subsequently transferred into the open form tool (51).

24. Method in accordance with claim 23, characterized in that first the long-fibre-reinforced mass (2) is laid into the form tool, thereafter the transport mesh (31) with the continuous fibre strands (3) is transferred into the open form tool and finally the pressing takes place.

25. Method in accordance with claim 21, characterized in that first the preformed supporting structure (4a) is formed and cooled down to such an extent, that it is non-deformable, subsequently transferred to the tool, fixed and if so required superficially heated up to such an extent, that during pressing it is completely thermoplastically bonded with the long-fibre mass (2).

26. Method in accordance with claim 21, characterized in that first a first partial structure (4.1) made of continuous fibre strands is fixed in the tool, then the long-fibre mass (2) is fed in and pressed, subsequently heated up again and a second partial structure (4.2) made of continuous fibre strands is fed-in and with a second pressing process completely thermoplastically bonded.

27. Method in accordance with claim 26, characterized in that first continuous fibre strands (3.1) forming a partial structure (4.1) are laid into the lower mould half (51.1), thereafter the long-fibre mass (2) is fed-in and a first pressing takes place, whereupon press and form tool are opened again, on the long-fibre mass (2) a laying path for a second layer of continuous fibre strands is melted open on the surface by means of local heating, continuous fibre strands (3.2) forming a second partial structure (4.2) are laid on it and subsequently pressed and in doing so thermoplastically bonded with the long-fibre mass (2).

28. Method in accordance with claim 21, characterized in that first the beginning (3A) of a continuous fibre strand is fixed on the tool, subsequently laid under slight tension and its end (3E), again while maintaining a certain tension, is fixed on the form tool (51), e.g., by means of tensioning elements (80).

29. Method in accordance with claim 21, characterized in that several continuous fibre strands (3) with internal connecting areas, resp., cross-over areas (7) are laid one after the other, so that a framework-like supporting structure (11) is produced.

30. Method in accordance with claim 21, characterized in that the continuous fibre strands (3) are pressed onto the mould by the laying device (54) dosed in such a manner, that the strands lie flat and assume the desired position and cross-sectional shape in the form tool. (51).

31. Method in accordance with claim 21, characterized in that the continuous fibre strands (3), resp., the supporting structure (4) are at least partially, i.e., at the beginning (3A), at directional changes of the laying path and at the end (3E) melted (41) onto the mould.

32. Method in accordance with claim 21, characterized in that the continuous fibre strands (3) through contact with the cooler form tool (51) are solidified to such an extent, that they remain fixed during pressing and that they in doing so, however, on the other hand at their interfaces (6) completely fuse together again with the long-fibre mass (2).

33. Method in accordance with claim 21, characterized in that at least at the beginning (3A) and end (3E) or also within a continuous fibre strand in molten condition eyes (43) for fixation are melted-in by pressing and partial solidifying and that these formed ends (3A, 3E) after the laying of the continuous fibre strand (3) are superficially melted open again by the hot long-fibre molten mass.

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34. Method in accordance with claim 21, characterized in that at least at the ends (3A, 3E) or also within the melted open continuous fibre strands holding elements (45) with plug-in holes (46) are melted open, which during the laying of the hot long-fibre mass (2) fuse together with it.

35. Installation (50) for the implementation of the method in accordance with claim 21, characterized by a long-fibre plastifying - and feeding device (52), a two-part form tool (51) in a press (56) and a continuous fibre strand plastifying device (53) with a laying device (54) or a transfer device (55) assigned to it as well as with a control system (57) for the co-ordinated in time controlling of the movement of the installation components and for the temperature conditioning, for the laying of the continuous fibre strands (3), resp., for the formation of a preformed supporting structure (4a) with internal connecting areas (7) and for the corresponding-to-form feeding-in of the long-fibre molten mass (2) as well as for the thermoplastic bonding (6) of continuous fibre strands (3) and long-fibre matrix (2) as well as by assigned fixing means (61, 62, 66, 69, 75, 80) for the fixation of the continuous fibre strands (3) during the manufacturing process, so that the desired integrated supporting structure (4) results.

36. Installation in accordance with claim 35, characterized in that fixing - and tensioning elements like fixing pins (61) and deviating elements (62) for the continuous fibre strands are located on the lower half of the form tool (51.1).

37. Installation in accordance with claim 36, characterized in that the fixing pins and deviating elements are movable (63) and when the press (56) is closed are pushed against a pre-tensioning (65) by the upper mould half (51.2).

38. Installation in accordance with claim 36, characterized in that the fixing pins have a controlled drive (64) and are utilizable for removing the component from the mould.

39. Installation in accordance with claim 36, characterized in that the fixing - and tensioning elements (61, 80) are attached outside the structural component (1) to be manufactured, but inside the form tool (51).

40. Installation in accordance with claim 35, characterized in that the tool has shapings like channels (66) and steps (67), with which the laid continuous fibre strands (3) are held in place during pressing.

41. Installation in accordance with claim 40, characterized in that the shapings, i.e., the laying paths (39) in the tool are thermally insulated (73), resp., conditioned (74).

42. Installation in accordance with claim 35, characterized in that the laying device (54) has guiding -, shaping - and pressing-on means, e.g., in the form of guide rollers (68) and pressure rollers (69).

43. Installation in accordance with claim 35, characterized in that a transport mesh (31) is foreseen for the laying of the continuous fibre strands of the supporting structure (4a) with an inlay mesh (32) in a transfer frame (33) for the transfer into the press, whereby the inlay mesh (32) after the pressing is integratable into the structural component (1) and the transfer frame is provided with a new inlay mesh for the next cycle.

44. Installation in accordance with claim 35, characterized in that a consolidation device (58) is assigned for the continuous fibre strands.

45. Installation in accordance with claim 35, characterized in that a heated store (59) for the continuous fibre strands is foreseen, from which the cut-to-length consolidated continuous fibre strands (3) are taken, melted open and utilized for the formation of the supporting structure (4a).

46. Installation in accordance with claim 35, characterized in that a hot gas - and/or a protective gas conditioning (71) are/is foreseen.

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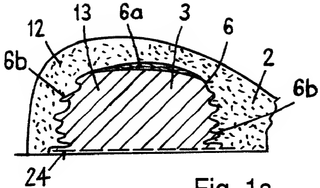

Fig. 1a

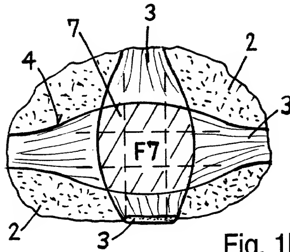

Fig. 1b

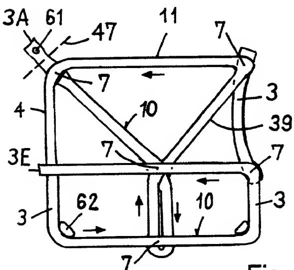

Fig. 3

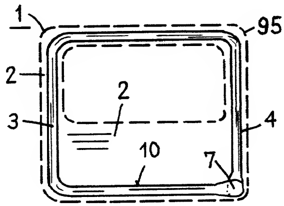

Fig. 2

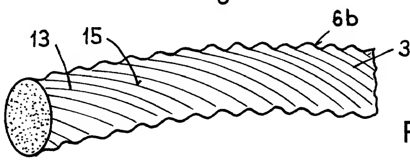

Fig. 4

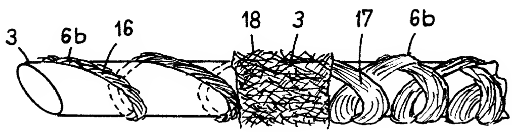

Fig. 5

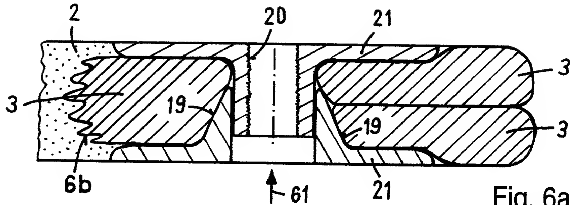

Fig. 6a

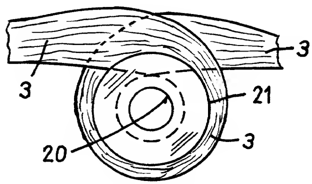

Fig. 6b

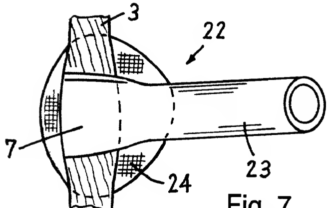

Fig. 7

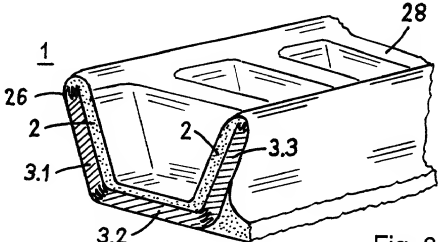

Fig. 8

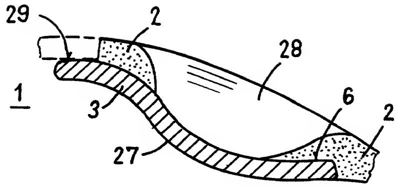

Fig. 9

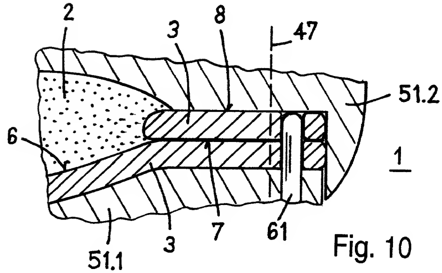

Fig. 10

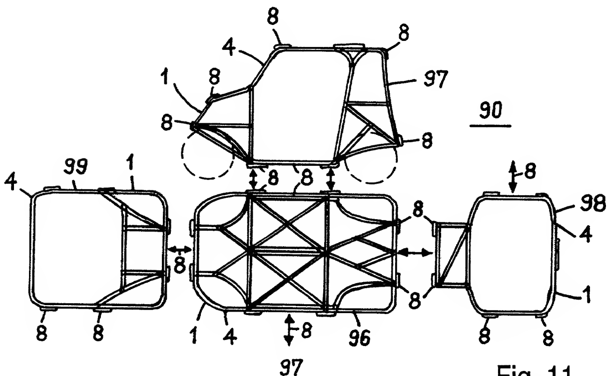

Fig. 11

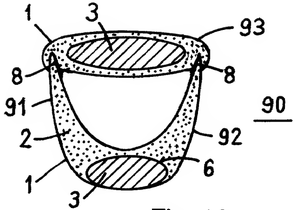

Fig. 12

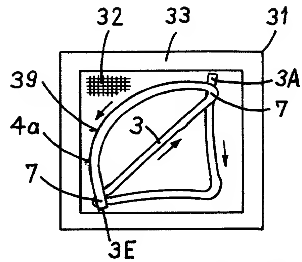

Fig. 13

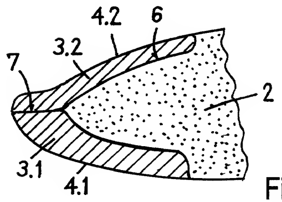

Fig. 14

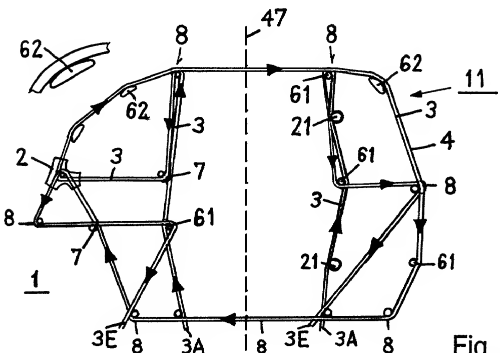

Fig. 15

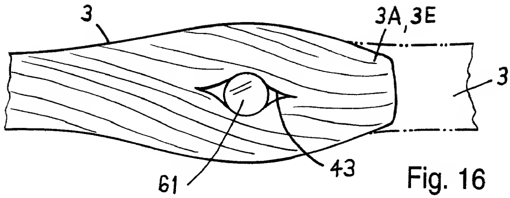

Fig. 16

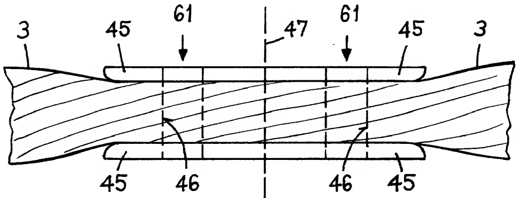

Fig. 17

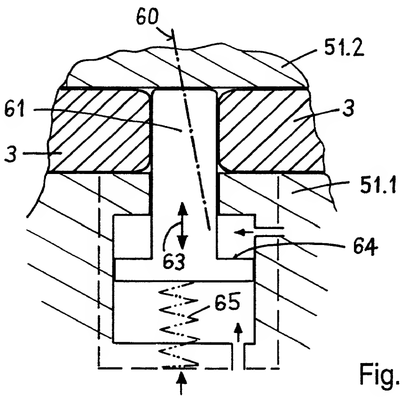

Fig. 18

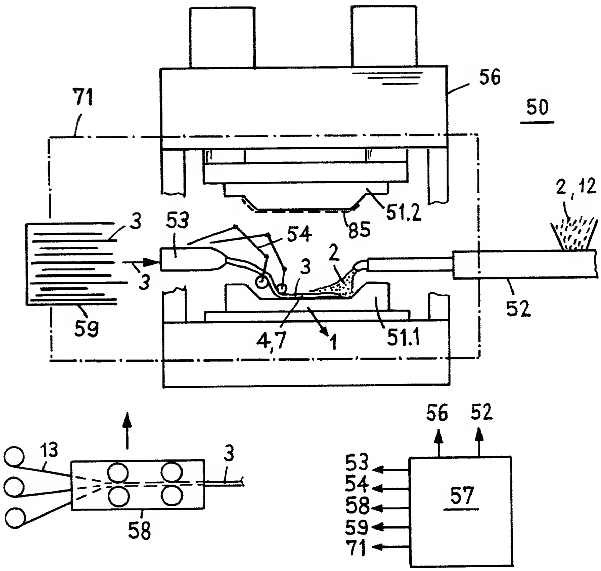

Fig. 19a

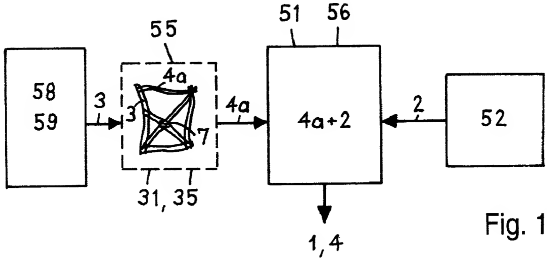

Fig. 19b

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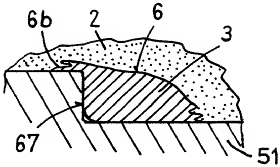

Fig. 20a

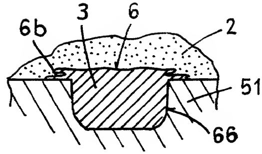

Fig. 20b

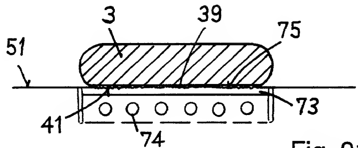

Fig. 21

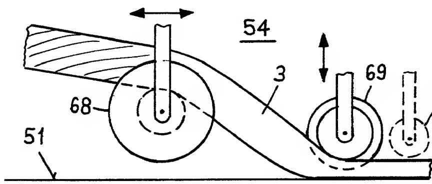

Fig. 22a

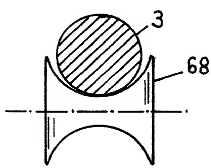

Fig. 22b

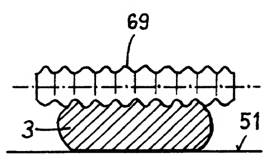

Fig. 22c

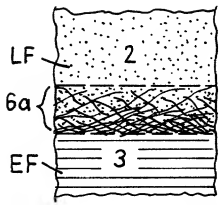

Fig. 23a

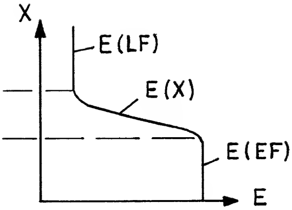

Fig. 23b

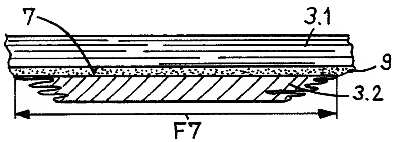

Fig. 24a

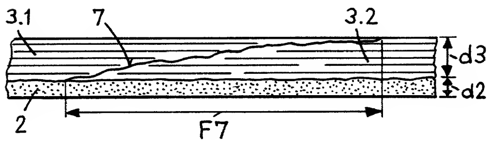

Fig. 24b

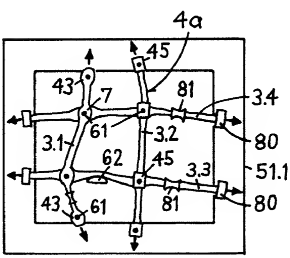

Fig. 25

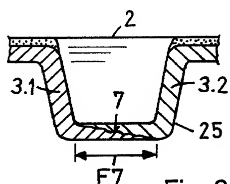

Fig. 24c

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FILE NO. WLANP001
INVENTOR Kägi et al.

COMBINED DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My citizenship, residence and post office address are as listed below next to my name.

I believe I am the original, first and [ ] sole/[x] joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled: Structural Component Consisting of Fibre-Reinforced Thermoplastic Plastic

the specification of which

(a) [X] is attached hereto.

(b) [ ] was filed on______________ as Application Serial No. ______________ and was amended on __________.

(c) [ ] was described and claimed in International Application No. ________ filed on _______ and amended on __________.

Acknowledgment of Duty of Disclosure

I hereby state that I have reviewed and understood the content of the above identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to the patentability of the subject matter claimed in this application in accordance with Title 37, Code of Federal Regulations § 1.56(a).

35 U.S.C. § 120

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose material information as defined in 37 CFR § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status)(patented,pending,abandoned)	(Patent No. if applicable)

(Application Serial No.)	(Filing Date)	(Status)(patented,pending,abandoned)	(Patent No. if applicable)

Power of Attorney

I hereby appoint Carl Oppedahl, PTO Reg. NO. 32,746, Marina T. Larson, PTO Reg. No. 32,038, and Nancy J. Parsons, PTO Reg. No. 40,364 of the firm of OPPEDAHL & LARSON LLP, having office at P.O. Box 5068, Alpine Bank Center, 2nd Floor, 256 Dillon Ridge Rd., Dillon, CO 80435 as attorneys to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

SEND CORRESPONDENCE TO:
OPPEDAHL & LARSON LLP

021121

PATENT TRADEMARK OFFICE

DIRECT TELEPHONE CALLS TO:
OPPEDAHL & LARSON LLP
(970) 468-6600

FILE NO. WLANP001
INVENTOR Kägi et al.

Claim for Priority

I hereby claim foreign priority benefits under 35 U.S.C. § 119 (a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign applications for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

EARLIEST FOREIGN APPLICATION(S), FILED WITHIN TWELVE MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION					
COUNTRY	APPLICATION NO.	DATE OF FILING (day/month/year)	DATE OF ISSUE (day/month/year)	PRIORITY CLAIMED	CERTIFIED COPY ATTACHED
WO	PCT/CH99/00150	14/04/1999		YES[x] NO[ ]	YES[ ] NO[x]

FOREIGN APPLICATION(S), IF ANY, FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION				
COUNTRY	APPLICATION NO.	DATE OF FILING (day/month/year)	DATE OF ISSUE (day/month/year)	
CH	861/98	15/04/1998		

Provisional Application

I hereby claim the benefit under 35 U.S.C § 119(e) of any United States provisional application(s) listed below.

(application number) (filing date)

(application number) (filing date)

(application number) (filing date)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR	LAST NAME KÄGI	FIRST NAME PETER	MIDDLE NAME
RESIDENCE & CITIZENSHIP	CITY OF RESIDENCE TANN CH	STATE OR COUNTRY OF RESIDENCE SWITZERLAND	COUNTRY OF CITIZENSHIP CH
POST OFFICE ADDRESS Turnerstrasse 2		CITY Tann	STATE/COUNTRY ZIP CODE Switzerland CH-8632
DATE 27. Sept. 2000		SIGNATURE P. Kägi	

[X] Signature for additional joint inventor attached. Number of Pages 1.
[ ] Signature by Administrator(trix) or legal representative for deceased or incapacitated inventor. Number of Pages ___.
[ ] Signature for inventor who refuses to sign or cannot be reached by person authorized under 37 CFR § 1.47. Number of Pages __.

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FILE NO. WLANP001
INVENTOR Kägi et al.

NAME OF SECOND INVENTOR 2-00	LAST NAME JAGGI	FIRST NAME DIEGO	MIDDLE NAME
RESIDENCE & CITIZENSHIP	CITY OF RESIDENCE ZÜRICH CH X	STATE OR COUNTRY OF RESIDENCE SWITZERLAND	COUNTRY OF CITIZENSHIP CH
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DATE 27 SEPTEMBER 2000		SIGNATURE	